# RELATIONS BETWEEN THE MLT ASCP BOARD OF REGISTRY EXAMINATION AND GRADES IN MLT PROGRAM COURSES AND THE RESPECTIVE CLEP SUBJECT EXAMINATIONS

BY

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DEDICATED TO

CRES ROUSH

Who would have been very proud.

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By

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The purpose of this study was to determine whether a relation existed between selected medical technology subject sub-scores on the American Society of Clinical Pathologists Board of Registry Examination for medical laboratory technicians, grades in analogous medical laboratory technology program courses, and scores on the respective College Level Examination Program Subject Examinations in medical technology.

The study participants were 63 second-year students from all six associate degree Medical Laboratory Technician Programs in Florida who (1) completed the program during spring or summer 1978, (2) took the Board of Registry Examination in August 1978, and (3) granted the researcher

permission to have access to their official college transcripts, CLEP Subject Examination scores, and Board of Registry Examination score and sub-scores.

Multiple regression was the statistical technique applied to the data to determine if there was a relationship between the dependent variable and the independent variables. Multiple regression was employed as an inferential tool by which the relationships in the population could be evaluated from the examination of the sample data.

Four null hypotheses were tested to determine whether a relationship existed between the dependent variables: the clinical chemistry, microbiology, hematology and immunohematology sub-scores on the Board of Registry Examination and the independent variables: student's grades in analogous medical laboratory technician courses and the respective CLEP subject examinations in medical technology. The independent variable measures were matched with the dependent variable measures for each participant.

Results of the statistical analysis revealed a significant relationship at the 0.01 level, between students' scores on the CLEP Subject Examinations, grades in the respective medical laboratory technician courses, and analogous sub-scores on the Board of Registry Examination.

In each of the four analyses, the corresponding null hypothesis was rejected. Since there was a significant relationship between scores on the CLEP Subject Examinations in clinical chemistry, microbiology, hematology, and

immunohematology, students' analogous grades, and the respective sub-scores on the Board of Registry Examination, the multiple regression equation was further examined to determine if the addition of the second independent variable, course grade(s), significantly enhanced the equation. An F test to determine the significance of the difference between multiple regression coefficients was performed. These calculated F values demonstrated that the addition of the general chemistry and the immunohematology course grade did not significantly enhance the relationship between the respective CLEP Subject Examination score and the analogous Board of Registry Examination sub-score at the 0.05 level. However, the addition of the clinical chemistry, microbiology, and hematology grades did significantly contribute to the relationship with the sub-score on the Board of Registry Examination at the 0.05 level.

Results of this study provide evidence to support the use of the CLEP Medical Technology Subject Examination as one mechanism for upward mobility for Associate of Science in medical laboratory technology graduates who subsequently enroll in baccalaureate degree medical technology programs. The findings also indicate the scores on the CLEP Subject Examinations in Medical Technology can be used to predict students' success on the MLT Board of Registry Examination.

# CHAPTER I

## INTRODUCTION

During the 1970s, allied health programs expanded to include two-year associate degrees and one-year certificate programs. The emergence of the two-year associate degree medical laboratory technician (MLT) is one result of the expansion of allied health programs in community colleges. Since the MLT has been chosen as the subject of this study, background information regarding the education and technical level of this laboratory professional was necessary.

The medical laboratory technician is still considered a relatively new laboratory worker. As defined by the American Society of Clinical Pathologists, this individual is one who has graduated from a two-year community college, or has an equivalent education, who will be able to perform more complicated laboratory procedures than the laboratory assistant (a graduate of a one-year technical program), and who will require only limited supervision.

The accreditation of a medical laboratory technician is done by the American Medical Association after recommendation by the National Accrediting Agency for Clinical Laboratory Sciences. Certification is granted to medical laboratory technician graduates who pass the Board of

Registry Examination. The examination is prepared and administered by appointed examiners under the auspices of the American Society of Clinical Pathologists. The Board of Registry is presently recognized as the authoritative qualifying body in this field by the American Medical Association, American Hospital Association, Catholic Hospital Association, and American College of Physicians.

In addition to professional recognition through certification, the MLT graduate in Florida must also comply with state requirements for licensure of laboratory personnel in order to be legally employed within the state. One of these is the licensure examination.

In spite of the growth of associate degree allied health programs in the community colleges, a manpower shortage still existed in the health disciplines (U.S. Department, HEW, 1971).

Such shortages lent impetus to the modification of the rigid curricula leading to such degrees, and to consideration of granting credit by examination. Equivalency examinations had been developed in the social sciences and humanities, with none in the health sciences.

The first allied health group to develop equivalency examinations included organizations representing various facets of medical technology. In 1970, the National Institutes of Health and Educational Testing Services entertained the concept of developing college course equivalency tests (subject examinations) in four subjects common to most

medical technology degree programs. The College Entrance Examination Board and the Educational Testing Service contracted with the National Institutes of Health to develop College Level Examination Program (CLEP) examinations in clinical chemistry, immunohematology, hematology, and microbiology.

Medical laboratory training is sometimes obtained in ways that do not meet the requirements for certification as an MLT. These ways may include on-the-job training, military training without academic courses, high school programs, and proprietary schools not approved by the American Medical Association. The graduates of one-year technical programs who have been certified as laboratory assistants may wish to employ some means by which they can achieve upward mobility. The CLEP examinations are one method that can be used to evaluate learning experiences that do not meet the traditional requirements for certification. Though conventional wisdom has long suggested that even the best examinations were insufficient by themselves to assess the particular technical skills necessary to adequately perform in certain job classifications, the CLEP examinations were developed in medical technology to provide a means whereby people could gain college credits for learning gained outside the traditional classroom setting.

## Statement of the Problem

The purpose of the study was to determine whether a relationship existed between selected sub-scores on the American Society of Clinical Pathologists Board of Registry Examination for medical laboratory technicians, and grades in analogous medical laboratory technology program courses and scores on the respective College Level Examination Program Subject Examinations.

No standardized tests for medical laboratory subjects were available to (1) compare a student's knowledge of medical laboratory disciplines with that of other student groups throughout the country, and (2) aid students in diagnosing their own strengths and weaknesses in medical laboratory specialties to aid them in preparing for a national certification examination. The implications of positive relationships between CLEP Subject Examinations and Board of Registry sub-scores tend to be directed toward possible utilization of CLEP Subject Examinations in two ways. The first implication is the acceptance of a predetermined achievement level on a particular CLEP subject examination in lieu of taking the college course, thus providing an alternate pathway for a student to earn credit in professional courses.

No standard achievement tests of any other means were available to assess a student's knowledge of medical laboratory subjects gained outside the traditional classroom setting.

The second implication is the employment of the CLEP examinations as a diagnostic tool, for both students and educators to measure students' academic achievement in medical laboratory courses.

If cognitive competencies of MLT graduates could be adequately measured, educators could then identify those technologist (four-year) competencies that remain to be mastered, thus granting the student maximum opportunity for upward mobility from MLT to the baccalaureate level. Such measurement tools could also be used to aid medical laboratory technology graduates in identifying their academic achievement and in preparing themselves for the National ASCP Board of Registry Certification Examination. Educators could benefit by assessing overall success of a student group on each of the subject examinations. A less-than-expected performance by a group of students may point to the need for curriculum revisions or considerations of alternate methods of presentation.

The study was designed to answer the following questions:

Question 1: Do grades in the college MLT program and related science courses--hematology, clinical chemistry, microbiology, and immunohematology--relate to scores on the MLT Board of Registry Examination?

Question 2: Do scores on the CLEP Subject Examinations in microbiology, immunohematology or blood

banking, hematology, and clinical chemistry relate to sub-scores on the MLT Board of Registry Examination in microbiology, immunohematology or blood banking, hematology, and clinical chemistry.

In order to answer these questions, the following null hypotheses were generated:

Hypothesis I

There is no relationship between the clinical chemistry sub-score on the MLT Board of Registry Examination and the student's general chemistry grade, clinical chemistry grade and clinical chemistry CLEP score.

Hypothesis II

There is no relationship between the microbiology sub-score on the MLT Board of Registry Examination and the student's microbiology grade, and microbiology CLEP score.

Hypothesis III

There is no relationship between the immunohematology sub-score on the MLT Board of Registry Examination and the student's immunohematology grade and immunohematology CLEP score.

Hypothesis IV

There is no relationship between the hematology sub-score on the MLT Board of Registry Examination and the student's hematology grade and hematology CLEP scores.

All hypotheses were tested at the .01 level of significance.

## Assumptions

For the purpose of this research, it was assumed that:

1. The CLEP subject examinations in medical technology were valid and reliable instruments for measuring (cognitive) knowledge of the said laboratory disciplines.
2. The Board of Registry Examination for Medical Laboratory Technicians was a valid and reliable instrument for measuring (cognitive) knowledge of the medical laboratory disciplines.
3. Volunteer participants were representative of the population of medical laboratory technicians in Florida.
4. Individuals in the sample would respond to the best of their ability in a sincere manner.
5. The sample population participated in curricula similar in overall content to the one defined in the "Essentials of an Approved Program for Medical Laboratory Technicians," published by the National Accrediting Agency for Clinical Laboratory Sciences.

## Limitations and Delimitations

All community junior college medical laboratory technician programs in Florida participated in this research.

The population was limited to second-year MLT students who were to graduate from the MLT program in 1978 and who took the ASCP Board of Registry Examination for Medical

Laboratory Technicians in August 1978. From this population, only those individuals who took the CLEP Subject Examination(s) and whose transcripts and registry scores were available to the researcher could be used for this research.

Only second-year medical laboratory technician students in these programs were included, since first-year students had not completed enough medical laboratory technician courses to be prepared for the Board of Registry Examination or the CLEP subject examination in medical laboratory disciplines.

Instruments used for this research measured only the knowledge and understanding of medical laboratory disciplines and did not include measurement of laboratory psychomotor skills.

## Definition of Terms

American Society of Clinical Pathologists (ASCP), a professional organization devoted to the interests of those engaged in the medical specialty of pathology and to the encouragement of research in the clinical laboratory.

Analogous, similar, for example the general chemistry courses and clinical chemistry courses are analogous to the clinical chemistry CLEP examination.

Board of Schools, a standing committee of the American Society of Clinical Pathologists from 1949-1973, formed to handle the accreditation of medical laboratory programs.

Certified Laboratory Assistant (CLA), an individual with a high school diploma (or equivalent) who has completed an accredited twelve-month post-secondary, structured laboratory assistant program.

College Entrance Examination Board (CEEB), a non-profit membership organization that provides tests and other educational services for colleges and universities.

College Level Examination Program (CLEP), an examination program sponsored by the College Entrance Examination Board to enable individuals who have acquired their education in non-traditional ways to demonstrate academic achievement. The CLEP Examinations are of two types: a battery of five general examinations which measure a general education background, and subject examinations, each covering one academic subject (College Level Examination Program, 1969). Only the subject examinations were used in this study.

Generalist, an individual who has been educated and trained in the clinical laboratory disciplines of hematology, clinical chemistry, immunohematology, microbiology, and urinalysis.

Grade Point Average (GPA), a scale of one to four points, with a grade of A being equal to 4 points, a grade of B being equal to 3 points, a grade of C being equal to 2 points, and a grade of D being equal to 1 point. No points are assigned to a grade of F.

Educational Testing Services (ETS), a non-profit organization responsible for, among other things, constructing the CLEP examinations through the use of appropriately composed committees. Additionally, ETS is responsible for the adminstration and scoring of the CLEP examinations.

Medical Laboratory Technician (MLT), individuals with an Associate in Science in medical laboratory technology, having graduated from a community junior college MLT program that included a structured curriculum in medical laboratory science and courses in chemistry and biology or physiology.

Medical Laboratory Technician Registry Examination, a certifying examination for medical laboratory technicians administered by the Board of Registry of the American Society of Clinical Pathologists. Eligibility to sit for the MLT (ASCP) certification examination includes an associate degree with courses in biology and chemistry, plus a structured curriculum of medical laboratory techniques. Certification as MLT (ASCP) requires successful completion of the Board of Registry Examination.

Medical Technologist (MT), individuals with a Bachelor of Science in Medical Technology or a Bachelor of Science degree that includes 16 semester hours in chemistry, 16 semester hours of biology, and one semester hour of math, plus one year of a structured accredited program in medical laboratory techniques.

National Accrediting Agency for Clinical Laboratory Sciences (NAACLS), an independently incorporated, non-profit corporation, currently cosponsored by the American Society for Medical Technology and the American Society of Clinical Pathologists. It is responsible for accreditation of clinical laboratory science programs in collaboration with the American Medical Association, and transcript evaluation. These functions were formerly held by the Board of Schools.

National Certification Agency for Medical Laboratory Personnel (NCA), an independent, autonomous, credentialing agency incorporated January 17, 1977. The NCA was established in response to the desire of many laboratory personnel to create a certifying agency responsible to the profession and administratively independent in matters pertaining to certification of qualified individuals.

The Board of Registry of the American Society of Clinical Pathologists, a certifying body for medical laboratory personnel of all levels, one level being the medical laboratory technician. The body operates within the corporate structure of the American Society of Clinical Pathologists (ASCP).

## CHAPTER II

## REVIEW OF RELATED STUDIES

### Related Studies

The initial review of literature included a search to establish the validity of using standardized examination scores and/or college course grades as predictors for success on professional certification examinations.

The nursing profession, through the National League for Nursing (NLN), offers achievement tests that compare a student's knowledge in the nursing specialties with a group of students from a variety of nursing programs throughout the country. These achievement tests are used to aid students in gaining experience in taking standardized examinations and in diagnosing their own strengths and weaknesses in the nursing specialties (Anguluan, 1973; Bell and Martindell, 1976).

National League for Nursing studies have reported a significant relationship between the State Board Examination (SBE) for nursing and scores on the verbal portion of the Scholastic Aptitude Test (National League for Nursing, 1971). Asher, Feldhusen and Miller (1968) positively correlated 22 variables with the State Board Examination. Mueller and Lyman (1969) found that NLN Achievement Tests have a strong

relationship to the SBE. Mullenkamp (1971), using a combination of grade-point averages and NLN Achievement Tests, also found a high correlation with the State Board Examination. Anguluan (1973) concluded that National League for Nursing achievement test scores were significantly related to success on the Nursing State Board Examination. This finding is supported by earlier research by both Brandy (1966) and Baldwin, Mowbray and Taylor (1968), who concluded that the NLN achievement tests were significant predictors of success on Nursing State Board Examinations. Thus, evidence indicates that the NLN Achievement Tests correlate with the State Board Examinations for nursing (Brandt, Hastie and Schuman, 1966; Papcum, 1971). These findings have particular relevance to this study because of the similar organization of NLN achievement tests with the CLEP subject examination in medical technology and the Nursing State Board Examination with ASCP registry examination. Each is a cognitive general examination composed of a series of individual examinations for each specialty area of the respective discipline.

## The Development of the College Level Examination Program (CLEP) in the Medical Laboratory Sciences

In the early 1970s, many medical and allied health professional groups expressed concern about the problems of licensure and certification in health occupations (Hatch, Pennel and Proffitt, 1971; Egelston, 1970). The American

Medical Association (AMA), in conjunction with the American Hospital Association (AHA), formed a committee to develop licensure standards for health personnel (American Hospital Association, 1970). The American Society of Allied Health Professions (ASAHP), in cooperation with the AMA Council on Medical Education and the National Commission on Accreditation, sponsored a study of selected health education programs, with emphasis on the relationship of program accreditation to individual licensure and certification (U.S. Public Health Service, 1971).

The National Institutes of Health, Bureau of Health Manpower Education, sponsored a conference in Washington in May 1971, to obtain opinions about credentialing in the health occupations. A few months later, in September, a conference on "Equivalency Testing for Allied Health Manpower" was held in Maryland (National Institutes of Health, 1970). These conferences were responses to the Public Health Services Act of November 1970, which contained a request from Congress for information concerned with the proper and efficient utilization of health personnel in meeting the health manpower needs of the nation (Shimberg, 1972). The Senate Ways and Means Committee expressed concern:

> Reliance solely on specific formal education or training or membership in professional organizations might seem to disqualify those whose work experience and training might make them equally or better qualified than those who meet the existing requirements (U.S. Senate, Ways and Means Committee, 1971).

The Senate Ways and Means Committee added an amendment to the Social Security Act of 1970, requiring the Secretary of Health, Education and Welfare to develop a program to determine the proficiency of health personnel who did not meet the formal education, professional membership, or other criteria established for determining the qualifications of practical nurses, therapists, laboratory technicians and technologists (U.S. Senate, Ways and Means Committee, 1971). This bill did not pass the 91st Congress, but was reintroduced and passed in the 92nd Congress as H.R. 1, with a provision for proficiency testing. The NEW Professional Examination for medical laboratory personnel was developed in response to this bill.

In June 1971, the U.S. Department of Health, Education and Welfare published the "Report on Licensure and Related Health Personnel Credentialing," which recommended additional study be directed toward the feasibility of establishing education equivalency measures and job performance examinations as alternatives to advanced educational placement, licensure or certification of health personnel. The report stated, "...the Department encourages the development of meaningful equivalency and proficiency examinations in appropriate categories of health personnel for entry into education programs and occupational positions. Individual states were called upon to assist in the implementation of this effort by amending licensing laws, when necessary, to recognize such examinations for the purpose of granting

advanced educational or job placement..." The report continued, "...when the validity of such examinations has been established and proficiency is more adequately assessed, reasons then exist to supplement the single formal educational approach with a multi-experience route.... The availability of effective testing instruments will enable individuals who, due to their military training and experience, can demonstrate their competence, to move directly into health service careers" (U.S. Senate, Ways and Means Committee, 1971).

Early in 1970, under contract Number 70-H047, the Division of Allied Health Manpower, Bureau of Health Manpower Education, National Institute of Health, Public Health Service, U.S. Department of Health, Education and Welfare, contracted with the College Level Examination Program (CLEP) to develop college course equivalency tests (subject examinations) in four core courses commonly included in medical technology degree programs (National Committee for Careers in Medical Technology, 1970). Specifically, the Eduacational Testing Service (ETS) and the College Entrance Examination Board (CEEB) were requested to develop College Level Examination Program (CLEP) subject examinations in the following medical technology disciplines: clinical chemistry, microbiology, immunohematology, and hematology. These examinations were normed in 1972, and became available for use in 1973. The tests followed the model of the other 29 CLEP subject examinations in other academic fields. This

venture was supported by the National Institutes of Health and major professional organizations such as the American Society of Clinical Pathologists, American Society for Medical Technology, American Medical Technologists, Association of Schools of Allied Health Professions, American Society of Allied Health Professions, and National Committee for Careers in Medical Technology (National Committee for Careers in Medical Technology, 1970).

The CLEP examinations provide a mechanism for obtaining college credit for information gained through non-traditional means. The College Level Examination Program is sponsored by the College Entrance Examination Board and administered by the Educational Testing Service. This endeavor is endorsed by the Commission on the Accreditation of Service Experience, the American Council on Education, the Federation of Regional Accrediting Commissions of Higher Education, supported by the Carnegie Commission, and accepted as the basis for awarding credit by more than 900 American colleges and universities (College Level Examination Program, 1969).

## Development of Medical Laboratory Technician Programs

Two major trends occurred in society during the late sixties and early seventies: an effort to provide post-secondary education for all who seek it, and a movement toward providing comprehensive health care for all. The junior college movement played a part in these trends, and

with the growth of junior and community colleges came new programs in the allied health fields (Connelly, 1972). Hitchcock concluded a speech at the 37th Annual Convention of the American Society for Medical Technology by stating that, "The needs of an expanding population and a concerned society demand more adequate health care for individuals. The associate degree professional has aided in meeting the increased demand for health care, and has become an indispensible part of the health care team." Hitchcock continued that these sub-professionals will be prepared through two-year colleges (Hitchcock, 1970). With the inception of associate degree allied health programs, a committee representing the National Health Council and the American Association of Junior Colleges published A Guide for Health Technology Program Planning (American Association of Junior Colleges, 1967). The monograph delineated general guidelines for building strong programs within two-year collegiate institutions through the collaboration of junior colleges with health practitioner associations and community health facilities.

One of the two-year allied health programs developed in the junior and community colleges was the medical laboratory technician program. As late as 1967, no common job description for the medical laboratory technician graduate had been developed, nor had a certification process for this new worker been agreed upon. Such job descriptions and

certification processes had previously been developed for other levels (MT and CLA) of laboratory professionals. As more junior colleges began developing these two-year laboratory programs, additional study of the new two-year curriculum was urgently undertaken. The American Association of Community and Junior Colleges and the National Council on Medical Technology Education formed a joint committee for this purpose. The work of this committee led to a better understanding of the interests and objectives of community and professional organizations concerned with laboratory medicine. The outcome of the committee's labor was a published guideline, directed toward the development of skilled technical workers in laboratory medicine. The product was the Guide for Program Planning: Medical Laboratory Technician (Kahler, 1969). This publication complemented the 1967 guide by applying the principles outlined for allied health programs to MLT curricula.

The Board of Registry of the American Society of Clinical Pathologists administered the first certifying examination for medical laboratory technicians in November 1969. The examination requirements for MLT (ASCP) certification included an associate degree, with courses in biology and chemistry, plus a structured curriculum of medical laboratory techniques. Structured curriculum had not been defined and there were no course outlines for the procedures identified for a satisfactory hospital clinical laboratory experience.

As an increasing number of medical laboratory technicians completed these new programs, certification measures were developed to assure minimum competence for this new level of laboratory professional. In 1972, The American Society of Clinical Pathologists established an MLT committee (American Society of Clinical Pathologists, 1973) with representation from the Board of Registry, the Board of Schools (now the National Accrediting Agency for Clinical Laboratory Sciences), educators, and members from both the American Society of Clinical Pathologists and the American Society for Medical Technology. This committee was given responsibility for recommending standards for medical laboratory technician programs and preparing a certifying examination. The "Essentials of Approved Schools for Medical Laboratory Technicians" was published in 1972. By 1973, the American Society for Medical Technology, House of Delegates, had approved a position paper describing the entry-level competencies for certified laboratory assistants, medical laboratory technicians, and medical technologists, with a recommendation that further delineations be made (American Society for Medical Technology, 1973).

## Board of Registry Certification Examination

The Board of Registry of the American Society of Clinical Pathologists (ASCP) has been administering certifying examinations for medical technologists since 1933 (National Institutes of Health, 1971).

The first examination included a written essay portion, a laboratory practical test, the examiner's evaluation of personal and psychological attributes, and consideration of the individual's previous general training (National Institutes of Health, 1971).

Suggested procedures for the performance portion of the examination were made available to the examiners, but there was no uniform method for evaluating the individual's performance.

By 1937, the examination had been changed to include only a written and practical section, each having equal weight. This pattern was followed until 1944. Two factors had contributed to this change. The Board of Registry experienced staff shortages, and technologists were unable to travel to examination centers.

Studies of the examination results revealed that those who failed the practical examination also failed the written portion of the examination; therefore, the practical portion of the examination was discontinued (U.S. Department, HEW, 1969).

The ASCP Board of Registry administered the first certifying examination for laboratory assistants in 1964. Candidates had to have a high school diploma and be graduates of an approved twelve-month hospital-based program, or graduates of an approved military medical laboratory course and have subsequently had one year of supervised laboratory experience.

The MLT certification examination, the most recently developed generalist certifying examination, was first administered in November 1969 (National Institutes of Health, 1971).

The ASCP Board of Registry offers three levels of generalist certification examinations: the medical technologist, the medical laboratory technician, and the certified laboratory assistant, more recently termed the medical laboratory technician--certificate.

The ASCP published the first in a series of five newsletters explaining the examination content guidelines used by the Board of Registry in the construction and evaluation of its generalist examination for medical technologist, medical laboratory technician---associate degree, and medical laboratory technician---certificate, CMLP Newsletter (American Society of Clinical Pathologists, 1974).

These publications identified the knowledge areas represented on the generalist certification examinations: microbiology, hematology, chemistry, immunology and immunohematology, and miscellaneous topics, which included urinalysis and laboratory mathematics. The examination contains 200 questions proportioned according to knowledge (subject) area. Approximately 40 questions are allocated to each of the knowledge (subject) areas (American Society of Clinical Pathologists, 1975).

The newsletter included a general outline of the knowledge area and a grid which graphically displayed the

emphasis given each content area, topic and sub-topics for each level of generalist examinations. As an example of a specific question in quality control for hematology, the MLT would be expected to demonstrate knowledge of how to record these data on a chart and make some judgments concerning their validity. The medical technologist would do this plus demonstrate a capability for establishing the quality control procedures and troubleshooting problems that arise in the quality control program.

The Board of Registry published this information to inform educators, students and laboratory personnel about the areas they deemed of prime importance for the evaluation of competence at the career entry level of the various categories of medical laboratory personnel (Commission on Medical Laboratory Personnel, 1977).

This grid was used to compare the taxonomy levels and the number of questions used for each category of the generalist examination, and to compare the expected capabilities of the medical technologist, the medical laboratory technician, and the certified laboratory assistant.

## Achievement and Equivalency Testing in Medical Technology

The granting of equivalent college credit, regardless of how or where learning had been achieved, was one of the major educational issues considered in the 1960s (Venn, 1964).

Few achievement tests or equivalency examinations pertaining specifically to medical technology or any clinical specialties within the profession have been developed to assess life experiences for granting appropriate college credit. One method for the evaluation of achievement in the clinical laboratory disciplines had been published by Carroll (1974). This report demonstrated a workable model, but was much too difficult to administer to a large number of students.

As Director of Education of the American Society of Medical Technology, Levine (1969) said that while individuals who have mastered skills outside of formal education programs should receive credit for them, this ideal was difficult to implement. Perry, at the Annual Meeting of the American Society of Clinical Pathologists, made a strong plea for the implementation of a career mobility plan for better utilization of laboratory personnel (Perry, 1970).

One method for the preparation and evaluation of equivalency examinations in medical technology was reported by Wise (1969). These examinations were intended to be used to provide academic credit for knowledge gained in a non-traditional setting, in order that students could meet the requirements for a specific level of clinical laboratory employment. The literature contains no further evidence that the examinations from this study were used.

A later study that involved the construction and validation of an equivalency examination for an MLT-MT career

mobility curriculum at the University of Illinois Medical Center was reported by Ciurczak and Schoeff (1980). The examinations were administered to applicants seeking advanced standing in the medical technology program at the University of Illinois. The authors reported that these examinations could be used to determine the applicant's level of competence, thereby facilitating individualizing courses in the program. To date, the authors have not collected enough data to focus clearly on where a medical laboratory technician should "leave off," and where a medical laboratory technologist should begin, in each of the professional subject areas.

Another study which employed equivalency testing in medical technology was done by Dumoff, Johnston, and Shoemaker (1977). The authors employed the college-level examination program subject examinations in hematology, microbiology, immunohematology and clinical chemistry, to compare scores of medical laboratory technician graduates with the baccalaureate degree medical technology graduates. The research included 18 medical laboratory technician graduates and 37 medical technology graduates in the Kansas City area. Results showed that some medical laboratory technician graduates were able to achieve the 50th percentile on the immunohematology subject examination. However, most of the medical laboratory technicians did not reach the 50th percentile on the clinical chemistry and hematology subject examinations. The authors reported that these scores

were comparable to a passing grade. The majority of the medical laboratory technicians did score above the 50th percentile on the microbiology subject examinatinon. The authors' only conclusions were to report that quantitative analysis was beneficial as a pre-clinical academic course, since those students who completed this course achieved at least a 22 percent higher mean percentile rank than those students who had not completed this course. The data also supported the ETS statement that the microbiology examination was designed to measure the material covered in a one-semester introductory course in that area, and was not specifically directed toward clinical microbiology (Dumoff, Johnston and Shoemaker, 1977).

Further examination of the literature indicated that no studies had been conducted to demonstrate a relationship between the score of any or all sub-scores on the Board of Registry Examination for medical laboratory technicians and the respective scores on the CLEP Subject Examination in Medical Technology, and the analogous medical laboratory technician course grades.

Additional encouragement for this study is provided by Wilson who points out that students should not have to undergo experiences designed to develop what is already possessed (Wilson, 1976).

# CHAPTER III

## PROCEDURES

Differences in academic and technical training directly relate to differing job descriptions and professional functions. The Board of Registry has developed a method for assessing students' knowledge at various levels in the cognitive domain.

The Board of Registry chose to organize the various levels of certifying examinations according to the taxonomy levels as defined by Bloom (1956). Taxonomy level 1, Recall; Taxonomy level 2, Comprehension; Taxonomy level 3, Application; Taxonomy level 4, Analysis; and Taxonomy level 6, Evaluation, were the levels used to organize the examination. Synthesis, Taxonomy level 5, was not included since questions written at this level did not lend themselves to a multiple choice testing format.

There were basic differences in the job descriptions and professional functions of the three medical laboratory professionals: MT, MLT, and MLT (C), formerly CLA. The MLT (C) has been educated and trained to perform tasks of a repetitive nature under supervision with a minimal amount of independent judgment. The medical laboratory technician

has been educated and trained to perform more complex tasks under supervision and may exercise some independent judgment concerning analysis of data. The medical technologist, however, was expected to perform the most complex tasks and exercise a great degree of independent judgment in all areas of laboratory and quality control procedures. By organizing the examination according to Bloom's taxonomy, the Board of Registry was able to weigh the examinations appropriately. For example, the MT examination was heavily weighted in the middle taxonomic levels, whereas the MLT (C) examination was most heavily weighted in the lower taxonomic levels.

## Description of the Medical Techology CLEP Subject Examinations

The four CLEP Subject Examinations in Medical Technology were clinical chemistry, hematology, immunohematology (blood banking), and microbiology.

The specific topics covered in the Clinical Chemistry CLEP Subject Examination were general and clinical chemistry principles and techniques, laboratory instrumentation, specific procedures for analyzing of blood, urine, and other body fluids, and the interrelationship of test results to the disease states. Additional topics included aspects of quality control and toxicologic studies.

About 40 percent of the questions in this 90-minute test required the recall of knowledge, about 20 percent

required comprehension as well as knowledge, about 30 percent were based on application of knowledge, and about 10 percent involved analysis and evaluation.

The specific topics covered in the Hematology CLEP Subject Examination included the development and components of blood, collection of specimens, hemoglobin determinations, counting the formed elements of blood (differential counts, leukocytes, erythrocytes), hemoglobin disorders and hemostasis.

The Hematology examination, like the other CLEP Subject Examinations in Medical Technology, included similar percentages of questions that required recall, comprehension, application, and evaluation.

The Immunohematology (blood banking), CLEP Subject Examination included knowledge of the history and general principles of blood transfusion; the antigen-antibody reaction; ABO blood type system; M, K, and P blood types; the Rh system; the Kell and Duffy blood types; the Lewis types; other blood type systems; detection of new blood type systems; pretransfusion procedures; leukocyte and platelet groups; blood types in anthropology and forensic pathology; auto-immune acquired hemolytic anemias; principles of blood banking procedures; and serological tests on donor blood. The percentage of test questions devoted to recall, comprehension, application and evaluation were similar to other CLEP Medical Technology Subject Examinations.

The CLEP subject examination in microbiology covered the understanding of the nature of microorganisms, virology, nutrition and metabolism of bacteria, microbial genetics, control of microorganisms, microbiology of water and foods, basis of infectious diseases, resistance and immunity, the pathogenic cocci and the diseases they cause, gram negative bacteria including entrics, gram positive bacilli, the spirochetes and the spriochetal diseases, and non-pathogens.

The percentage breakdown of the type of questions on the microbiology examination was similar to the other CLEP subject examinations.

## Description of the Board of Registry Certification Examination Knowledge Areas

Five knowledge areas were represented on the Board of Registry Examination: microbiology, hematology, clinical chemistry, immunohematology (blood Banking), and miscellaneous topics that included urinalysis, management and supervision. Forty questions were devoted to each knowledge area, for a total of 200 questions on the examination. The Board of Registry provided examination scores for each separate knowledge area, and a total composite score to the student and the particular medical laboratory technology program director.

The clinical chemistry knowledge area included laboratory instrumentation, the physical and chemical principles involved in operation and maintenance of laboratory

instruments, and the theory and application of physiological biochemistry; to include the test procedures performed on biological fluids, their interpretation, quality control in test procedures, and new test development.

The majority of questions on the clinical chemistry portion of the examination required recognition or recall, comprehension, and application of knowledge. The Board of Registry did not publish a breakdown by percentages, but did outline the subject material covered in each subject area, and the possible number and level of questions devoted to each topic listed in the outline.

The immunohematology knowledge area covered antigen-antibody reactions, humoral and cellular immunity, auto-immunity, serodiagnostic tests, donor selection, blood collection and specimen processing, preparation and use of blood components, administration of blood and blood components and quality control procedures for the blood bank. The majority of questions in this knowledge area for the MLT level were recall or recognition, comprehension, and application of knowledge in blood banking.

The hematology knowledge area included the formation, morphology, function, differentiation and enumerative procedures for erythrocytes, leukocytes, and platelets. The theory of normal and abnormal hemostasis, and basic coagulation tests were also covered on this portion of the examination. In addition to questions requiring recall,

comprehension and application of knowledge, a relatively small number of analysis and evaluation questions were included.

The microbiology knowledge area tested the students' knowledge of the morphology, cultural characteristics, identification of gram positive cocci, gram positive aerobic and anaerobic rods, mycobacteria, and yeast and yeast-like molds. Parasitology was also included. The physiological importance, effects, and treatment of microbial pathogens were also covered on the examination.

No questions in the microbiology section of the examination required evaluation at the medical laboratory technician level. Most of the questions required recall, comprehension and application of knowledge in microbiology, with a small number of questions requiring analysis.

## Sample Selection

There are six associate degree medical laboratory programs in the Florida community college system. These programs are located at:

Brevard Community College, Cocoa

Florida Junior College, North Campus, Jacksonville

Indian River Community College, Fort Pierce

Miami Dade Community College, Medical Center Campus, Miami

St. Petersburg Junior College, Clearwater Campus, Clearwater

Valencia Community College, West Campus, Orlando.

The subjects of the study included second-year laboratory technician students from all six of the MLT-AD programs in Florida. To insure the protection of the rights of these human subjects, this research was cleared by the College of Education Committee for the Protection of Human Subjects (Appendix B).

Permission to conduct the research was obtained through the appropriate administrative channels at each community college. The researcher then arranged the date and time for the administration of the CLEP Subject Examinations with each MLT program director. The program directors cooperated by explaining the purpose and benefits of the research to those students who would be participating in the study.

The initial criteria for selection of the participants required that the student be enrolled in the final semester of study in an MLT-AD program. Each MLT-AD program was represented. The final criteria for selection of the sample were that the student had:

1. completed the MLT-AD Program,
2. completed the CLEP Subject Examinations administered by the researcher (with permission of and according to protocol established by ETS),
3. taken the Board of Registry Certifying Examination, August 1978,
4. granted the researcher permission, in writing, to have access to their official college transcripts,

CLEP Subject Examination scores, and Board of Registry Examination Score and Sub-scores (Appendix A).

In the six MLT-AD programs, 102 second-year students in their final semester of study took the CLEP Subject Examinations. Of these 102 students, 63 also took the Board of Registry Certifying Examination for Medical Laboratory Technician, August 1978. These 63 students comprised the final sample for this study.

## Data Collection

### Collection of Grades

Each MLT program director provided this researcher with transcripts of those students who participated in the study. Transcripts were mailed to the researcher after the participating students had graduated from the program and after all medical laboratory courses had been recorded.

### Collection of CLEP Medical Technology Subject Examination Scores

The researcher visited each of the six MLT-AD programs to administer the CLEP subject examinations. All testing was conducted in well-ventilated, lighted, and quiet classrooms. The examinations were administered in the same order to each group of students and according to the directions provided by ETS. Educational Testing Service scored the

subject examinations and provided the researcher with a copy of the scores. The researcher made no variations from the standard published ETS procedures for the administration and mailing of the CLEP subject examination.

Collection of the Board of Registry Scores

Each of the students involved in the study took the MLT Board of Registry Examination, August 19, 1978. Upon receiving the school report of examination scores from the Board of Registry, each program director provided this researcher the examination scores of the students who participated in this study.

# CHAPTER IV

## ANALYSIS OF DATA AND RESULTS

The preceding chapters contain a statement of the questions, including statements of hypotheses, review of pertinent literature, and the procedures used in the study. In the first hypothesis, the independent variables were the student's general chemistry grades, clinical chemistry grades, and Clinical Chemistry CLEP Subject Examination scores. The dependent variable was the MLT Board of Registry Examination sub-score in clinical chemistry. In the second hypothesis, the independent variables were the student's clinical microbiology grades and Microbiology CLEP Subject Examination scores. The MLT student's Board of Registry Examination sub-score in microbiology was the dependent variable. In the third hypothesis, the student's immunohematology grades and the Immunohematology CLEP Subject Examination score were independent variables and the MLT Board of Registry sub-score in immunohematology was the dependent variable. The student's hematology grades and the Hematology CLEP Subject Examination score were independent variables for the fourth hypothesis, with the MLT Board of Registry sub-score in hematology the dependent variable.

## Treatment of the Data

Multiple regression analysis was chosen to test each hypothesis. This statistical procedure was used to determine if a relationship existed between the dependent variable and the combination of the independent variables and, if so, whether the relationship was significant (Kim and Kohout, 1970). This was done separately for the data in each hypothesis.

This technique also permitted the researcher to determine whether the relation between the dependent variable and the independent variable that first entered the equation was enhanced by the addition of independent variables.

## Descriptive Statistics Concerning the Variables

### Grades

The mean grade-point average for the 63 MLT students completing the medical laboratory courses in immunohematology, clinical chemistry, general chemistry microbiology, and hematology, ranged from 2.6 to 3.1, with the highest average in immunohematology and the lowest in general chemistry (averages rounded to the nearest decimal).

This was not an unexpected outcome, since all the programs employed a selective admission process. Table 1 provides a more detailed description of the distribution of students' grades.

TABLE 1

DESCRIPTIVE STATISTICS CONCERNING STUDENTS' GRADES

| Variable | Range (0-4.0) | Mean | Standard Deviation |
|---|---|---|---|
| Microbiology Grade | 2.0 - 4.0 | 3.00 | 0.76 |
| Clinical Chemistry Grade | 1.0 - 4.0 | 2.85 | 0.71 |
| Immunohematology Grade | 1.0 - 4.0 | 3.07 | 0.66 |
| Hematology Grade | 2.0 - 4.0 | 2.99 | 0.62 |
| General Chemistry Grade | 1.0 - 4.0 | 2.55 | 0.82 |

CLEP Medical Technology Subject Examination Scores

The maximum possible score on each of the CLEP subject examinations was 100. Table 2 shows mean scores for the CLEP subject examinations, as follows: Microbiology, 50.13; Clinical Chemistry, 37.92; Immunohematology, 36.50; Hematology, 38.81.

It is possible that the higher mean score (Guilford and Fruchter, 1973) on the Microbiology CLEP Subject Examination, as compared to the mean scores on the other three subject examinations, could be a function of the examination content. This examination, unlike the other Medical Technology CLEP Subject Examination, measured understanding and knowledge of cognitive areas of microbiology usually presented in a one-semester general course. Little of the information tested in this examination was clinically related. All the medical

TABLE 2

DESCRIPTIVE STATISTICS CONCERNING STUDENT'S CLEP MEDICAL TECHNOLOGY SUBJECT EXAMINATION SCORES

| Variable | Range (0-100) | Mean | Standard Deviation |
|---|---|---|---|
| Microbiology CLEP Score | 36.0-68.0 | 50.13 | 7.15 |
| Clinical Chemistry CLEP Score | 20.0-61.0 | 37.92 | 9.60 |
| Immunohematology CLEP Score | 20.0-63.0 | 36.50 | 8.10 |
| Hematology CLEP Score | 20.0-60.0 | 38.81 | 10.22 |

laboratory technician students who participated in the study had had general microbiology and clinically oriented microbiology laboratory courses prior to taking the examination.

Board of Registry Sub-Scores

The maximum possible score for each subject area on the Board of Registry Examination was 40. The mean sub-scores for each of the knowledge areas for the student sample were Microbiology, 25.45; Clinical Chemistry, 26.58; Immunohematology, 26.36; Hematology, 28.94, as shown in Table 3.

The respective national sub-score means, as reported by the Board of Registry, are presented in Table 4. These sub-score means ranged from 25.29 for Microbiology to 28.94 for Hematology.

TABLE 3

DESCRIPTIVE STATISTICS CONCERNING SELECTED SUB-SCORES ON THE BOARD OF REGISTRY EXAMINATION FOR MEDICAL LABORATORY TECHNICIANS

| Variable | Range (0-40) | Mean | Standard Deviation |
|---|---|---|---|
| Microbiology Sub-score | 5.0-36.0 | 25.45 | 6.13 |
| Clinical Chemistry Sub-score | 17.0-35.0 | 26.58 | 4.47 |
| Immunohematology Sub-score | 14.0-35.0 | 26.36 | 5.32 |
| Hematology Sub-score | 20.0-38.0 | 28.94 | 4.85 |

TABLE 4

COMPARISON OF SAMPLE MEAN AND POPULATION MEAN OF SELECTED SUB-SCORES ON THE BOARD OF REGISTRY EXAMINATION FOR MEDICAL LABORATORY TECHNICIANS

| Variable | Subject Sample Mean | Population Mean |
|---|---|---|
| Microbiology Sub-score | 25.45 | 25.29 |
| Clinical Chemistry Sub-score | 26.58 | 25.74 |
| Immunohematology Sub-score | 26.36 | 26.33 |
| Hematology Sub-score | 28.94 | 27.49 |

A comparison of the sub-score means of the sample studied showed that they were very similar to the sub-score means of the population.

Zero order correlation coefficients of the independent variables with the respective sub-score on the MLT Board of Registry Examination were presented to indicate the degree to which the variation in individual sub-scores of the Board of Registry Examination was related to the variation in the grade and CLEP subject examnination score of the analogous subject. Correlations between the CLEP subject examinations and the Board of Registry Sub-scores were significant and relatively strong, ranging from 0.59 for the hematology subject examination to 0.65 for the microbiology subject examination. Relationships between course grades and registry sub-scores were more varied with only two, clinical chemistry and hematology, exceeding $p < .01$. The relationship between the Board of Registry sub-score and course grade in microbiology was significant at the .05 level, while no significant relationship was shown to exist between the Board of Registry sub-score and course grade in immunohematology. These data are summarized in Table 5.

It is desirable to know whether the correlation coefficients fall within the calculated confidence levels.

In order to set up the confidence intervals and limits, and to gain inferences concerning the accuracy of the sample correlation coefficients, Fisher's $Z$ transformation procedure

TABLE 5

CORRELATION OF STUDENTS' GRADES AND CLEP SUBJECT EXAMINATIONS WITH THE RESPECTIVE SUB-SCORES ON THE BOARD OF REGISTRY EXAMINATION FOR MEDICAL LABORATORY TECHNICIANS

| Variable | General Course Grade | Analogous MLT Course Grade | Analogous CLEP Subject Examination Score |
|---|---|---|---|
| Microbiology Board of Registry Sub-score | | .27* | .65** |
| Clinical Chemistry Board of Registry Sub-score | .48* | .54** | .62** |
| Immunohematology Board of Registry Sub-score | | .16 | .62** |
| Hematology Board of Registry Sub-score | | .42** | .59** |

*($p < .05$)
**($p < .01$)

was employed (Guilford and Fruchter, 1973). The $z$ coefficient, to which any correlation coefficient can be converted, either mathematically or by using the appropriate table, has a normal sampling distribution regardless of the sample size and the size of the population, $\bar{r}$ (correlation coefficient). An estimate of the population is not needed in order to determine the standard error of $z$. (The standard error of $z$ is independent of the size of the correlation coefficient, and depends upon the sample size.)

Transformation of correlation coefficients to Fisher's $z$ can be found in Table 6.

TABLE 6

FISHER'S z TRANSFORMATION OF CORRELATION COEFFICIENTS

| Variable | General Course | MLT Grade | CLEP Score |
|---|---|---|---|
| Microbiology Board of Registry Sub-score | | .27 | .78 |
| Clinical Chemistry Board of Registry Sub-score | .52 | .61 | .72 |
| Immunohematology Board of Registry Sub-score | | .16 | .72 |
| Hematology Board of Registry Sub-score | | .44 | .68 |

The standard error of the z coefficient was calculated using the following formula (Guilford and Fruchter, 1973):

$$z = \frac{1}{\sqrt{N-3}}$$

The correlation coefficient of the Clinical Chemistry CLEP Subject Examination with the clinical chemistry sub-score on the MLT Board of Registry Examination was 0.62. The corresponding z coefficient from Table 6 was 0.72. Using the formula for the calculation of the standard error of z, and a sample size of 62, the standard error of 0.13 was obtained. The confidence interval at the .95 level was 0.13 X 1.96, or 0.25. This value was added and subtracted from each z coefficient, e.g., 0.72 - 0.25 = 0.47,

0.72 + 0.25 = 0.97. The r value for the clinical chemistry CLEP Subject Examination did fall within the confidence intervals 0.47 - 0.97.

Fisher's z coefficient for the clinical chemistry grade was 0.61. To obtain the confidence interval 0.25 was added and subtracted to 0.61, which yielded a confidence interval of 0.36 - 0.86. The correlation coefficient for the clinical chemistry grade fell within the confidence interval.

The confidence interval for the general chemistry grade was calculated by adding and subtracting 0.25 from the Fisher z coefficient 0.52. The confidence interval was 0.27 - 0.77. The correlation for the general chemistry grade was 0.52, which was within this confidence interval.

The confidence intervals for the microbiology grade, microbiology CLEP examination score, hematology grade, hematology CLEP examination score, immunohematology grade, and immunohematology CLEP examination score were calculated by adding and subtracting 0.25 to the respective z coefficient. Values for these intervals are shown in Table 7. The r value for each of these independent variables fell within the calculated confidence interval. Therefore, the correlation coefficients calculated for this sample could be considered to be representative of the entire population.

TABLE 7

CONFIDENCE INTERVALS AT THE 0.05 LEVEL OF FISHER'S z COEFFICIENTS

| Dependent Variable | General Course | MLT Grade | CLEP Score |
|---|---|---|---|
| Microbiology Board of Registry Sub-score | | 0.02-0.52 | 0.03-1.03 |
| Clinical Chemistry Board of Registry Sub-score | 0.27-0.77 | 0.36-0.86 | 0.47-0.97 |
| Immunohematology Board of Registry Sub-score | | 0.09-0.41 | 0.47-0.97 |
| Hematology Board of Registry Sub-score | | 0.19-0.69 | 0.43-0.93 |

## Analysis of Data

Multiple regression was the statistical technique chosen because it allowed the researcher to evaluate the relationship between the dependent variable and the independent variables, as well as to examine the individual relationships of the independent variables to the dependent variable.

An increase in the number of independent variables in an equation may result in an increase in error variance, so that the parsimonious solution to an equation is desirable. To determine if the multiple correlation coefficient was enhanced significantly by the addition of variables beyond the first which entered the equation, an F test was performed (Guilford and Fruchter, 1973) at each step.

The formula used to calculate the F value was:

$$F = \frac{(R_1^2 - R_2^2)\ (N - m_1 - 1)}{(1 - R_1^2)\ (m_1 - m_2)}$$

where

$R_1$ = multiple R with the larger number of independent variables,

$R_2$ = multiple R with one or more variables omitted,

$m_1$ = larger number of independent variables,

$m_2$ - smaller number of independent variables.

The addition of the clinical chemistry grade yielded an F value of 3.21 (df 2, 59) that, when compared to the tables, F value showed a significant contribution at the 0.05 level to the multiple regression equation. However, the addition of the general chemistry grade yielded an F value of 0.92 (df 2, 59), which was not statistically significant.

Hypothesis I: There is no relationship between the clinical chemistry sub-score on the MLT Board of Registry Examination and the general chemistry grade, clinical chemistry grade, and the Clinical Chemistry CLEP Subject Examination Score.

The (zero order) correlation coefficient between the Board of Registry sub-score in clinical chemistry and the CLEP subject Examination in that subject was 0.62, ($F = 29.76$, $p < .01$). Addition of the course grade in clinical chemistry resulted in a multiple correlation coefficient of 0.65 ($F = 34.98$, $p < .01$). Adding the general

chemistry grade to the equation increased the multiple correlation to 0.66 ($F = 39.96$, $p < .01$). Table 8 illustrates this information.

TABLE 8

MULTIPLE CORRELATION OF THE CLINICAL CHEMISTRY SUB-SCORE ON THE BOARD OF REGISTRY EXAMINATION WITH THE GENERAL CHEMISTRY GRADE, CLINICAL CHEMISTRY GRADE, AND CLINICAL CHEMISTRY CLEP SUBJECT EXAMINATION SCORE

| Variable | B | BETA | Multiple R | df | F |
|---|---|---|---|---|---|
| Clinical Chemistry CLEP Examination Score | 0.18 | 0.37 | 0.62 | 2, 62 | 29.76* |
| Clinical Chemistry Grade | 1.44 | 0.23 | 0.65 | 2, 62 | 34.98* |
| General Chemistry Grade | 1.04 | 0.18 | 0.66 | 2, 62 | 39.96* |

*($p < .01$)

Since the multiple correlation coefficient reported for the equation which illustrated the relationship between the dependent variables and the combination of independent variables associated with Hypothesis I was significant, Hypothesis I was rejected.

Hypothesis II: There is no relation between the microbiology sub-score on the MLT Board of Registry Examination and the students' microbiology grade and microbiology CLEP score.

The zero order correlation between the board of Registry sub-score in microbiology and the CLEP subject examination in that subject was 0.65 ($F = 35.53$, $p < .01$). The addition of the microbiology course grade resulted in a multiple correlation coefficient of 0.68 ($F = 42.24$, $p < .01$), as noted in Table 9. On the basis of these correlations, this hypothesis was rejected.

To determine if the increase in the correlation coefficient was significantly enhanced by the addition of the microbiology grade, the F value of the increase was calculated. This resulting F value of 4.26 (df 1, 61) was significant at the 0.05 level ($p < .05$).

TABLE 9

MULTIPLE CORRELATION OF THE MICROBIOLOGY SUB-SCORE ON THE BOARD OF REGISTRY EXAMINATION WITH THE MICROBIOLOGY GRADE AND THE MICROBIOLOGY CLEP SUBJECT EXAMINATION SCORE

| Variable | B | BETA | Multiple R | df | F |
|---|---|---|---|---|---|
| Microbiology CLEP | 0.49 | 0.63 | 0.65 | 1, 62 | 35.53* |
| Microbiology Grade | 1.45 | 0.20 | 0.68 | 1, 62 | 42.24* |

*($p < .01$)

Hypothesis III: There is no relationship between the immunohematology sub-score on the MLT Board of Registry Examination and the students' immunohematology grade and the immunohematology CLEP score.

The zero order correlation between the Board of Registry sub-score in immunohematology and the CLEP subject examination in immunohematology was 0.62 ($F = 29.33$, $p < .01$). The addition of the immunohematology course grade resulted in a multiple correlation coefficient of 0.62, also ($F = 29.34$, $p < .01$). The hypothesis was rejected. The data are presented in Table 10.

To determine if the increase in the correlation coefficient was significantly enhanced by the addition of the immunohematology grade, the F value of the increase was calculated. The F value of 0.007 (df 1, 61) was not significant at the 0.05 level.

TABLE 10

MULTIPLE CORRELATION OF THE IMMUNOHEMATOLOGY SUB-SCORE ON THE BOARD OF REGISTRY EXAMINATION WITH THE IMMUNOHEMATOLOGY GRADE AND THE IMMUNOHEMATOLOGY CLEP SUBJECT EXAMINATION SCORE

| Variable | B | BETA | Multiple R | df | F |
|---|---|---|---|---|---|
| Immunohematology CLEP | 0.39 | 0.62 | 0.62 | 2, 62 | 29.33* |
| Immunohematology Grade | -0.08 | 0.01 | 0.62 | 2, 62 | 29.34* |

*($p < .01$)

Hypothesis IV: There is no relation between the hematology sub-score on the MLT Board of Registry Examination and the students' hematology grade and hematology CLEP score.

The zero order correlation between the Board of Registry sub-score in hematology and the CLEP subject examination in that subject was 0.59 ($F = 24.95$, $p < .01$). The addition of the hematology course grade resulted in a multiple correlation coefficient of 0.63 ($F = 31.29$, $p < .01$), as presented in Table 11. The hypothesis was rejected.

To determine if the addition of the hematology grade yielded a significant increase in the multiple correlation coefficient, the F value of the increase was calculated. The resulting F value of 4.57 (df 1, 62) was significant at the .05 level.

TABLE 11

MULTIPLE CORRELATION OF THE HEMATOLOGY SUB-SCORE ON THE BOARD OF REGISTRY EXAMINATION WITH THE HEMATOLOGY GRADE AND THE HEMATOLOGY CLEP SUBJECT EXAMINATION SCORE

| Variable | B | BETA | Multiple R | df | F |
|---|---|---|---|---|---|
| Hematology CLEP | 0.25 | 0.50 | 0.59 | 1, 62 | 24.95* |
| Hematology Grade | 1.86 | 0.23 | 0.63 | 1, 62 | 31.26* |

*($p < .01$)

# CHAPTER V

## SUMMARY OF THE STUDY

The major purpose of this research was to determine whether a relationship existed between selected medical technology subject sub-scores on the American Society of Clinical Pathologists Board of Registry Examination for Medical Laboratory Technicians, grades in analogous medical laboratory technician program courses, including general chemistry, and scores on the respective College Level Examination Program Subject Examinations in Medical Technology.

A review of the literature revealed that the development of the two-year associate degree community college medical laboratory technician programs began in the 1960s, and that the initial American Society of Clinical Pathologists Board of Registry Examination for medical laboratory technicians was administered in November 1969.

A review of literature concerning equivalency examinations in health disciplines showed a positive correlation between student performance on the National League for Nursing Achievement Tests, grade-point averages in the respective nursing courses, and performance on the State Board Examinations for Nursing.

Additional literature reported that equivalency examinations in medical technology subjects were developed by selected medical technologists through the Education Testing Services and the College Level Examination Program. These examinations were normed in 1972, at the baccalaureate level, and were made available for use in 1973.

Further examination of the literature indicated that no studies had been conducted to demonstrate a relationship between the score, or any combination of sub-scores on the Board of Registry Examination for Medical Laboratory Technicians and the respective scores on the CLEP Medical Technology Subject Examinations and the analogous medical laboratory technician course grades.

Four hypotheses were examined:

Hypothesis I:

No relationship exists between the clinical chemistry sub-score on the MLT Board of Registry Examination and the students' general chemistry grade, clinical chemistry grade, and the clinical chemistry CLEP score.

Hypothesis II:

There is no relationship between the microbiology sub-score on the MLT Board of Registry Examination and the students' microbiology grade, and microbiology CLEP score.

Hypothesis III:

No relationship exists between the immunohematology sub-score on the MLT Board of Registry Examination and the

students' immunohematology grade and the immunohematology CLEP score.

Hypothesis IV:

No relationship exists between the hematology sub-score on the MLT Board of Registry Examination and the students' hematology grade and hematology CLEP score.

The study participants included 63 second-year students from all six associate degree medical laboratory technician programs in Florida. These participants were students who met the following criteria:

1. completed the MLT program during spring or summer 1978,
2. took the CLEP Medical Technology Subject Examinations just prior to graduating from the MLT Program,
3. took the Board of Registry Examination for medical laboratory technicians, August 1978,
4. granted the researcher permission, in writing, to examine their official college transcripts, CLEP subject examination scores, and Board of Registry examination score and sub-scores.

The researcher visited each MLT Program to administer the four CLEP medical technology subject examinations and to obtain the participating students' written consent to have access to the data needed for the study.

The method chosen to test each hypothesis was multiple regression analysis. This procedure allowed a determination

as to whether a relationship existed between the dependent variable and a combination of the independent variable measures, and if so, whether the relationship was a significant one. This was done separately for the data in each hypothesis. The relationships between the dependent variable and each separate independent variable were also examined.

The findings of the multiple regression analysis demonstrated positive correlations between all subject sub-scores on the ASCP Board of Registry Examination and grades in analogous courses and scores on the CLEP subject examinations in medical technology. Based on these findings, all hypotheses were rejected.

Stated positively, the hypotheses accepted were:

I. A relationship exists between the clinical chemistry sub-score on the MLT Board of Registry Examination and the student's general chemistry grade, clinical chemistry grade, and clinical chemistry CLEP examination score.

II. A relationship exists between the microbiology sub-score on the MLT Board of Registry Examination and the student's microbiology grade and microbiology CLEP examination score.

III. A relationship exists between the immunohematology sub-score on the MLT Board of Registry Examination and the student's immunohematology grade and immunohematology CLEP examination score.

IV. A relationship exists between the hematology subscore on the MLT Board of Registry Examination and the student's hematology grade and hematology CLEP examination score.

Because in actual practice, an increase in the number of independent variables in the multiple regression equation may result in an increase in error variance, an F test was performed to determine if the addition of variables, beyond the first which entered the equation, significantly enhanced the correlation coefficient.

The calculated F value for the addition of the clinical chemistry grade was 3.21 (df 2, 62), which demonstrated that the clinical chemistry grade significantly contributed at the 0.05 level, to the correlation coefficient. However, the F value for the general chemistry grade was 0.92 (df 2, 62), which indicated that this variable did not significantly contribute to the multiple correlation coefficient. The calculated F value for the addition of the microbiology grade to the correlation coefficient was 4.26 (df 1, 61), which showed that this variable significantly contributed at the 0.05 level to the correlation coefficient. The F value calculated for the addition of the immunohematology grade to the equation was 0.007 (df 1, 61), which demonstrated that the addition of the student's immunohematology grade did not significantly contribute to the multiple regression equation. The addition of the hematology grade yielded a corresponding F value of 4.57

(df 1, 61), which indicated that the hematology grade significantly contributed at the 0.05 level to the multiple regression equation.

These results demonstrated that there was more variability among course grades than standardized test scores, which is congruent with current thinking, that test scores predict other test scores, and course grades have more error variance.

## CHAPTER VI

## CONCLUSIONS AND RECOMMENDATION

This study demonstrated a significant relationship between the CLEP Medical Technology Subject Examinations, course grades, and analogous knowledge areas on the Board of Registry Examination for medical laboratory technicians. These findings clearly indicate that the CLEP subject examinations can be used to predict success in those analogous areas included on the ASCP Board of Registry Examination. This prediction of success should apply equally well to other certification examinations for medical laboratory technicians, since they are basically similar in construction and content.

Major considerations concerning the supply of allied health manpower and the means for upward mobility of health workers must include mechanisms for the recognition of student's knowledge and skills gained outside the traditional college classroom or laboratory setting. Efficient utilization of currently available allied health manpower depends largely upon successful efforts to remove those barriers that impede career mobility, while remaining consistent with the professional established standards of service.

This study should encourage medical technology educators to consider the CLEP Subject Examinations in Medical Technology as one mechanism for granting credit in an associate degree program. As an example, the medical technology educator could employ the four CLEP subject examinations to assess the knowledge and understanding of the student who comes from a non-traditional learning situation.

Once the mechanism for the recognition of MLT professional credits has been established it can be used to verify the credits of applicants transferring from other programs. Educators could empirically establish the minimum score on the CLEP examination for credits that may be transferred into their program. Analysis of CLEP examination data from a particular program could assist educators in identifying the placement of a student in the curriculum of each subject area, microbiology, hematology, clinical chemistry, and immunohematology.

Professional organizations in allied health have urged the academic community to provide credit to those students who wish to have their knowledge of medical laboratory subjects measured by equivalency examinations. Credit by examination has been available in the areas of English, mathematics, and social sciences. However, academic institutions appear to be much more reluctant to give such credit for medical laboratory courses. Studies such as this should provide evidence for a change in philosophy.

Basic to the concept of career mobility is the need to assess each individual's skills, regardless of the route taken to attain them. Since the associate degree medical laboratory technician has become an integral part of the laboratory profession, ideally institutions should begin to explore the possibilities of offering alternate routes for students with varying academic backgrounds who wish to advance their professional standing. One such alternative route is the recognitition of previous educational accomplishments by equivalency examinations in the laboratory areas.

The CLEP subject examinations could also be used by students and educators in assessing the students' knowledge of a particular subject, thereby assisting in the identification of areas needing review or reinforcement, prior to the student's sitting for a national certification examination.

As part of a system for curriculum evaluation, educators should consider curriculum and instructional delivery revision, if students consistently demonstrate a weakness in one or more subject examinations.

The following recommendations for further study are suggested:

1. This study examined the relationships among cognitive subject areas in medical technology. Most MLT programs award grades for the demonstration of both clinical and cognitive proficiency, clinical proficiency in

this instance being those skills peculiar to the practice of medical technology. The relationship between grades awarded for knowledge of medical laboratory subjects, cognitive proficiency, and grades awarded for the attainment of corresponding clinical laboratory skills, psychomotor proficiency, should be examined.

2. In a like manner, the relationship between the subscores on the MLT Board of Registry Examination, the respective CLEP subject examinations in medical technology, and grades received for the attainment of clinical laboratory skills in the corresponding subject area should be examined.

APPENDIX A

INFORMED CONSENT FORM

I want to thank you for your willingness to take part in a state-wide project involving the CLEP Subject Examinations in Hematology, Clinical Chemistry, Blood Banking, and Microbiology.

I. The purpose of this study that involves all medical laboratory technician sophomore students in Florida is:

   1. to determine if these CLEP subject examination scores have any relationship to predicting the ASCP Board of Registry scores of medical laboratory technician graduates,

   2. to determine the average scores for medical laboratory technician sophomore students in Florida on these four CLEP examinations.

II. There should be no risk to you, the participant. Please be assured that your scores will be coded for this study, and no MLT student or school will be identified in any manner.

III. Benefits:

   1. You may request your CLEP scores be sent to you for your own use.

   2. You will gain practice in taking standardized examinations prior to taking the MLT ASCP Board of Registry examination.

IV. Your participation in this study is voluntary.

V. You will not receive any monetary compensation for participating in this study nor will you be charged for this study.

VI. Your signature:

1. indicates your consent to participate in this study, and to take the above mentioned CLEP examinations, and

2. gives me permission to have a copy of your complete transcript(s) at no cost to you, and your score and sub-scores on the Board of Registry Examination. I will obtain these from your institution or program director.

Signature: _____

Witness: _____

Principal Investigator: _____

Jo Ann Ahlstrom
Medical Laboratory Technician Program
St. Petersburg Junior College
2465 Drew Street
Clearwater, Florida 33515

APPENDIX B

COLLEGE OF EDUCATION
COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS

M E M O R A N D U M

To: Jo Ann Ahlstrom Date: April 27, 1978

From: William D. Wolking, Chairperson, Committee for the Protection of Human Subjects

Re: Project Title: Selected Factors Contributing to the Success of Medical Laboratory Technicians on the Certifying MLT ASCP Board of Registry Examination

Your project has been cleared by the College Committee for the Protection of Human Subjects. If the procedures indicated are carried out, the committee does not forsee risk to the participants. This should not be considered an endorsement of the general merit of this research, but only as assurance that we see no violations of the University's policies related to the use of human subjects.

Thank you for your efforts toward insuring the protection of the rights of human research subjects.

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## BIOGRAPHICAL SKETCH

Jo Ann Roush Ahlstrom was born October 13, 1947, in Tampa, Florida, where she later completed her elementary and secondary education. She attended the University of South Florida in Tampa and in 1967 was accepted into the Medical Technology Program at the University of Florida, Gainesville. She received the Bachelor of Science in Medical Technology, August 1969.

After graduation, she married Timothy John Ahlstrom and lived in Atsugi, Japan, working in the clinical laboratory at Camp Zama Army Hospital as a Red Cross Volunteer for six months.

She returned to the University of Florida Medical Center to accept a position as a research technologist in the Department of Pathology and in 1971 entered graduate school as a part-time student. From June 1972 to December 1974, she attended graduate school fulltime as a Kellogg Fellow, sponsored by the W. K. Kellogg Foundation. She received the Master of Education degree for health occupation educators in December 1972 and was elected to the Society of Phi Kappa Phi. She received the Specialist in Education degree with a major in curriculum and instruction

in June 1974 and began work on the Doctor of Philosophy degree in curriculum and instruction.

While studying for the Specialist degree, she was employed part time by St. Petersburg Junior College in Clearwater, Florida, and in June 1975 accepted a full time position as chairman of the Medical Laboratory Technician Program.

She has been certified as a medical technologist by the American Society of Clinical Pathologists since 1969 and a member of the American Society for Medical Technology since 1970.

I certify that I have read this study and in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

James W. Hensel, Chairman
Professor of Instructional
Leadership and Support

I certify that I have read this study and in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Margaret K. Morgan
Associate Professor of Instructional Leadership and Support

I certify that I have read this study and in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

M. Ruth Williams
Professor Emeritus of Medical
Technology

This dissertation was submitted to the Graduate Faculty of the Division of Instructional Leadership and Support in the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

June 1980

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Dean, Graduate School